

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Economic Guidance Memorandum 00-05, FY 2000 Shallow Draft Vessel Operating Costs

The enclosed information is provided for immediate use and should be used until new information is provided. Questions related to this memorandum should be addressed to Mr. Ron Conner, CECW-PD, at (202) 761-0132.

FOR DIRECTOR OF CIVIL WORKS:

Enclosure 1

Enclosure 2

/s/

JAMES F. JOHNSON  
Chief, Planning Division  
Directorate of Civil Works

## ENCLOSURE 1

### FY 2000 Planning Guidance Shallow Draft Vessel Costs

Prepared Under the Direction of:

U.S. Army Corps of Engineers  
Institute for Water Resources  
7701 Telegraph Road  
Alexandria, VA 22315-3868

Prepared for and Issued By:

Headquarters  
U.S. Army Corps of Engineers  
Directorate of Civil Works  
Planning Division  
20 Massachusetts Avenue  
Washington, D.C. 20314-1000  
FY 2000 Planning Guidance  
Shallow Draft Vessel Costs

## Table of Contents

<u>Section</u>	<u>Page</u>
I. Introduction	1
II. Estimated Towboat Costs (FY 2000 at 6.625 percent)	1
<u>Replacement Cost</u>	1
<u>Operating Costs</u>	2
<u>Administrative Costs</u>	4
<u>Fuel Consumption</u>	4
<u>Fuel Costs</u>	5
III. Estimated Barge Costs (FY 2000 at 6.625 percent)	5
<u>Replacement Cost</u>	5
<u>Operating Costs</u>	6
<u>Administrative Costs</u>	8
<u>Port Costs</u>	8
FY 2000 Estimated Daily Operating Costs for 10-11 Mississippi River System Towboats	
FY 2000 Estimated Daily Operating Costs for 12-17 Mississippi River System Barges	

## **FY 2000 Estimated Towboat and Barge Costs**

### **I - Introduction**

The towboat and barge costs shown on the accompanying spreadsheets are provided for use by Corps of Engineers planners in studies to determine the potential benefits of improvements to the Mississippi River and associated inland and intracoastal waterways of the United States. The costs have been updated by a survey of vessel owners and/or operators conducted during the spring of 1999, and reflect 1998 cost levels. The spreadsheet formats are unchanged from previous Planning Guidance. Daily costs are based on the Corps' current discount rate of 6.625 percent.

To facilitate the interpolation for vessel sizes not shown, and to provide consistency, formulas based on cost data and regression analyses were utilized to derive many of the line item costs. The specific results of these formulas are displayed to the nearest cent, but should not be taken as an indication of high precision. The following sections present the methodology applied and results presented in the current Planning Guidance spreadsheets.

### **II - Estimated Towboat Costs**

The towboat spreadsheets displayed on pages 10 and 11 presents total daily costs. Total daily operating costs are the sum of replacement and operating costs. Operating costs are comprised of crew-related and boat-related costs, administration costs, and fuel costs. Increases in crew wages and replacement costs outweighed the slight reduction in fuel cost resulting in greater total daily costs as compared to 1997 when vessel costs were last published. Total daily costs were greater than 1997 across all towboats horsepower categories by approximately 3.7 percent. The 400-600 horsepower range experienced the greatest percentage increase in daily costs as compared to 1997. Although the estimated replacement cost for this horsepower range was less than 1997, estimated operating costs and fuel consumption were greater resulting in a greater total daily cost. The average percent increase in daily costs for towboats with horsepower greater than 1,400

was 2.7 percent as compared to 1997. The largest increases in towboat daily cost were for those vessels of less than 1,400 horsepower.

**Replacement Cost.** Many firms noted a rule-of-thumb of \$1,000 per horsepower. Both shipyards and towboat owners/operators provided replacement cost data. Replacement costs provided by owners/operators represented both custom built and standard yard designs. Shipyard quotes were slightly higher than those reported by owners/operators. Prices quoted by owners/operators are more closely aligned with the price paid rather than the price quoted by the shipyards. The linear model derived to represent replacement cost is as follows:

$$\text{Replacement Cost} = - 115,160.513 + 1,203.75615 * \text{Horsepower}$$

The Standard Error of the Estimate is 612,343.77, Standard Error of the Coefficient is 30.77, and  $R^2$  is 0.95. Thus, the independent variable, horsepower, accounted for 95 percent of the variance of the dependent variable, replacement cost. The estimated replacement costs ranged from \$973 to \$1,192 per horsepower for the horsepower categories of 400-600 and 10,000, respectively. Replacement costs were converted to a daily cost using an amortization formula over a 20 year horizon at the current Corps project discount rate of 6.625 percent, divided by an estimated 350 operating days per year.

**Operating Costs.** Firms reported higher operating costs for this update than reported for the FY 97 Guidance. Many firms noted a significant increase in crew wages. A tight job market resulting in low unemployment has made it difficult for firms to find and retain personnel without paying increased wages as compared to 1997. The differences in operating cost were explained using the variable of horsepower. The model for estimating operating cost is as follows:

$$\text{Operating Cost} = 85.17918 * \text{Horsepower}^{(0.43407)}$$

The Standard Error of the Estimate is 0.15492, Standard Error of the Coefficient is 0.01015, and  $R^2$  is 0.81. Thus, the dependent variable of horsepower accounts for 81 percent of the variance of operating cost. The operating cost model indicates that a one-percent change in

horsepower would result in a 0.43 percent change in operating cost. The percent increase in the estimated operating costs as compared to 1997 ranged from 29 to 3 percent for the horsepower ranges of 400-600 to 10,000 horsepower, respectively. The largest increase in operating costs were reported in the lower horsepower categories.

As noted earlier, operating costs are comprised of crew-related and boat-related costs. Crew-related costs were estimated using a model developed from reported owner/operator data. The model for crew-related cost is as follows:

$$\text{Crew Cost} = 59.55987 * \text{Horsepower}^{(0.43332)}$$

The Standard Error of the Estimate is 0.17054, Standard Error of the Coefficient is 0.01164, and  $R^2$  is 0.77. Thus, the dependent variable of horsepower accounts for 77 percent of the variance of crew cost. The crew cost model indicates that a one-percent change in horsepower would result in a 0.43 percent change in operating cost. The percent increase in the estimated crew-related costs as compared to 1997 ranged from 35 to 7 percent for the horsepower ranges of 400-600 to 10,000 horsepower, respectively. The largest increases in crew-related costs were reported in the lower horsepower categories. As noted by the participating firms, the increase in crew-related costs is primarily a result of higher wages.

A model was attempted for boat-related costs. The independent variable, horsepower, did not explain the variance in boat-related costs well. Given a model based on horsepower accurately estimated total operating costs and crew related costs, boat related costs are calculated by subtracting crew costs from total operating costs.

Line item costs associated with the crew-related cost category include crew wages, fringe benefits, food and subsistence, and transportation. Line item costs associated with the boat-related cost category include maintenance and repair, supplies, insurance, and other (e.g., taxes). Individual costs comprising the two major categories were arrived at by applying the percentage distribution derived from the reported cost data. The percentages based on the latest data are similar to those presented in the FY 97 Guidance.

The percentage distribution among crew-related costs are as follows: crew wages 71% (versus 72.8% in FY 97 Guidance); fringe benefits (including training) 22% (versus 19.2%); food and subsistence 4% (versus 4.6%); and transportation 3% (versus 3.5%). The percentage distribution among boat-related cost is as follows: maintenance and repair 53% (versus 49.3%); supplies 20% (versus 16%); insurance 19% (versus 20.6%), and other 8% (versus 14.1%).

Note: For spreadsheet purposes, four cost categories represent crew and boat-related costs. The titles of most categories identify the costs included in the category. However, there are exceptions including "Insurance", which includes uninsured or self-insured property damage claims, and "Wages", which includes mandated payroll taxes. "Fringe benefits" and "Other" have been used to include a variety of miscellaneous crew and boat-related expenses. "Fringe benefits", in addition to the usual employer options such as health and life insurance as well as vacation and retirement benefits, includes training (because it is mostly paid time for participation), pre-employment and periodic medical exams and tests, personal injury claims and settlements, and safety awards and other bonuses. "Other" includes property taxes, which are usually minimal, but does not include fuel taxes (which are treated as part of fuel cost on the spreadsheet) or income taxes. The biggest "Other" expense is usually communications services, followed by waste disposal, safety and insurance inspections, and port charges and towboat assistance if applicable.

**Administrative Costs**. There is no uniformity in how overhead costs are reported by towboat owners/operators. Some firms charge the overhead to the towboat, others charge all overhead to the barge. Attempts to develop a model to estimate administrative costs were unsuccessful. Administrative costs were calculated as a percentage of operating costs. The percentage figure assigned to administrative costs was derived from cost figures reported by survey respondents. On average, administrative costs represented an additional 12 percent above total operating costs. The approximate percentage of administrative cost as a portion of operating cost for towboats of less than 2,500, 2,500 to 6,000, and greater than 6,000 horsepower was 12, 11, and 13 percent, respectively.

**Fuel Consumption.** Survey data provided by the owners/operators suggested the need for two models to represent two distinct transportation situations. The first model represents those towboats of less than 6,000 horsepower, typical of those towboats operating on rivers with locks such as the Ohio River. The second model represents towboats of greater than 6,000 horsepower typically operating on open rivers such as the middle and lower Mississippi River. The models were developed using the dependent variable, fuel consumption, and the independent variable, horsepower. These models are as follows:

$$\text{Fuel Consumption (f 6,000)} = 0.43666 * \text{Horsepower}^{(1.01279)}$$

$$\text{Fuel Consumption ( > 6,000)} = 0.04189 * \text{Horsepower}^{(1.31139)}$$

With respect to the model for vessels under 6000 horsepower, the Standard Error of the Estimate is 0.01117, the Standard Error of the Coefficient is 0.09033, and  $R^2$  is 0.71. The dependent variable, horsepower, accounted for 71 percent of the variance in fuel consumption for towboats less than or equal to 6,000 horsepower. With respect to the model for vessels with horsepower greater than 6000 horsepower, the Standard Error of the Estimate is 0.17813, the Standard Error of the Coefficient is 0.03552, and  $R^2$  is 0.73. The dependent variable, horsepower, accounted for 73 percent of the variance in fuel consumption for towboats greater than 6,000 horsepower. Both models indicate that a one percent change in horsepower would result in a greater than one percent change in fuel consumption.

In the FY 97 Guidance it was noted that a typical towboat diesel engine is rated at 1.25 gallons per horsepower per day under full load. In the current Planning Guidance towboat spreadsheets a line item is included entitled "HiPower" computed at fuel consumption of 1 gallon per horsepower per day. This line item is provided to represent those towboats utilizing 80 percent of full power.

**Fuel Costs.** Fuel prices for 1998 decreased from those reported for 1996. The average price paid by the firms that reported fuel costs was \$0.64. The median price paid



was \$0.69. According to the DOE data series, *Refiner/Reseller #2 Distillate for Resale*, the PAD II and PAD III average price was \$0.434 in 1998. The latest four-year average for the period of 1995 through 1998 was \$0.545 per gallon. The inland waterways tax and deficit reduction tax of \$0.20 and \$0.043, respectively, were added to the \$0.545 average price. Thus, the fuel cost applied in the Planning Guidance spreadsheets is \$0.788.

### III - Estimated Barge Costs

The barge spreadsheets displayed on pages 12 - 17 present total daily costs for different types of vessels (e.g., open hopper, covered hopper, deck, and tank barges) and different size classes. Port costs are also reported. Total daily costs are comprised of daily replacement costs, operating costs, and administrative costs. **Total** daily costs are slightly less for oil tank barges, the largest size classes of open hopper barges, covered hopper barges, and deck barges, and greater for self-unloading cement barges, chemical tank barges, and asphalt carrying barges when compared to FY 1997 Planning Guidance. Survey respondents reported greater daily operating costs for all barge types and size categories. Overall, total daily costs are 2% lower for open hopper barges, 9% lower for covered hopper barges, 1.5% lower for oil tank barges, and 2% higher for chemical tank barges when compared to the FY 1997 Planning Guidance.

**Replacement Cost.** Replacement costs for the various types and dimensions of barges shown (deck barges, all hopper barges, and most tank barges) on the spreadsheets were calculated with formulas that apply estimates of the number of labor hours required to construct a vessel and the cost of steel. Labor costs for a particular barge type and dimension are a function of estimated worker hours and Department of Labor average earnings for boatyard workers. Steel costs for a particular barge type and dimension are a function of the estimated barge steel weights and published steel prices. These formulas were first used in the FY 97 Guidance. In this Planning Guidance, 1998 boatyard worker earnings and steel prices were utilized to estimate barge replacement costs. Also, the additional costs for such items as keavils, chocks, manholes, hatches, pumps, piping, etc. were handled as a percentage or specific increase to

hull steel cost. As in the FY 97 Guidance, estimated costs include an overhead of 15% on materials, 100% on labor, and a 10% builder's margin.

Lower steel prices were reported in 1998, whereas labor rates were higher. The combination of these factors resulted in barge replacement costs that were 1% to 6% less than report in the FY 97 Guidance. Vessel types which did not record a decrease in construction cost included self-unloading cement barges, asphalt carrying barges, and ammonia carrying barges. As noted in the FY 97 Guidance, construction of self-unloading cement barges has not occurred in recent years. As a result of low demand for such vessels, the cost to construct such vessels is higher than previously reported. Quoted prices from survey respondents suggest an approximate 40% increase in construction cost as compared to the FY 97 Guidance. Greater costs were also quoted for both asphalt and ammonia barges and are reflected in the accompanying spreadsheets.

Overall, the formulas developed for the FY 97 Guidance for specific barge types and dimensions performed well in comparison to reported replacement costs. Thus, the formulas were used with 1998 labor rates and steel prices. There were certain exceptions including the self-unloading cement barge which was described above. Also, in the case of chemical tank barges, the prices presented in the FY 97 Planning Guidance were based on price quotes from survey respondents. In the 1999 field survey, few price quotes for chemical tank barges were provided, and to avoid disclosure problems, the FY 97 Guidance replacement costs were adjusted to reflect the reported decrease in the cost to construct other tank barges.

Overall, the replacement cost of open hopper barges, covered hopper barges, oil tank barges, and specialty tank barges is less than the prices reported in the FY 97 Planning Guidance by approximately 5, 6, 1, and 1 percent, respectively.

**Operating Costs.** Barge operating costs are comprised of four cost items: maintenance and repair, supplies, insurance, and other. Weighted averages of the operating cost items were utilized in updating the barge spreadsheets. The largest amount of cost data was available for deck barges, 195x35x12 open and covered

hopper barges, cement barges, 195x35x12 oil tank barges, and 195x35x12 chemical barges. Many firms noted that a large percentage of the barge fleet is reaching the age of 30 years in service and in order to keep the vessels operating with a high degree of efficiency, preventative maintenance costs are increasing.

Operating costs for the 195x35x12 open hopper are approximately 7% greater as compared to the FY 97 Planning Guidance. Recent data indicate greater operating costs for all open hopper barges. Overall, open hopper barge operating costs are greater than those reported in the FY 97 Guidance by approximately 30%. Again, more data were available for the 195x35x12 open hopper barge than the other open hopper dimensions. A ratio of cargo capacity of the other dimensions to the 195x35x12 vessel was applied to the operating costs of the 195x35x12 vessel to derive the other vessels operating costs. This method was compared to actual data for validation of results.

Similarly, operating costs are approximately 7% greater for the 195x35x12 oil tank barge as compared to the FY 97 Planning Guidance. Very little data was available for the remaining oil tank barge size categories as well as the pressurized and asphalt tank barges. The operating costs for these vessel types were derived by comparing the FY 97 Planning Guidance operating cost data for the tank barge classes (oil, asphalt, and pressurized) to the 1998 data for the 195x35x12 tank barge. These relationships were applied to the 195x35x12 tank barge operating costs (1998) to derive the operating costs for all other tank barges for the FY 1999 Planning Guidance. These estimated operating costs were verified against reported data where available. Overall, operating costs for the oil tank barges were greater than the FY 97 Guidance costs by approximately 6%. The operating costs of the asphalt, ammonia, and remaining pressurized tank barges were greater by approximately 27, 21, and 11 percent, respectively. Asphalt tank barge operating costs varied greatly among firms thus the estimate as described above was most appropriate.

Operating costs for the 290x50x13 self-unloading cement barge remained unchanged from the FY 97 Planning Guidance. However, recent data indicate that the operating costs associated with the smaller 195x35x13 cement barge are over twice that reported in the FY 97 Planning Guidance. To derive the operating cost for the smaller cement barge, the

ratio of capacity of the smaller cement barge to the larger was applied to the operating cost of the larger. These calculated costs were verified with actual data.

Operating costs are greater by 13 percent for the 195x35x12 chemical tank barges as compared to the FY 97 Planning Guidance. The total operating cost presented for the 195x35x12 chemical tank barge was derived from actual data. However, the distribution of total cost to the various cost components (maintenance and repair, supplies, insurance, and other) was derived from the FY 97 Planning Guidance. The operating costs for the remaining chemical tank barge dimensions were derived by comparing the FY 97 Planning Guidance operating cost of all chemical tank barges to the recent cost data for the 195x35x12 chemical tank barge and applying these relationships to the 195x35x12 tank barge operating costs (1998). These estimated operating costs were verified against reported data where available.

Note: The "Other" cost category has been used for taxes and miscellaneous barge operating costs. In addition, this cost includes inspections and condition surveys. The shore side services such as tankermen, the cost of pumpmen, firemen, and other barge equipment operators carried as part of the towboat crew are not included in the "Other" cost. Also, port costs comprised of shifting, fleeting, and cleaning are not included but are addressed in a later section of the Planning Guidance.

**Administrative Costs.** Similar to the overhead costs reported for towboats, barge overhead costs are inconsistent by type and dimension. The average overhead cost for the 195x35x12 open hopper, covered hopper, oil tank, and chemical tank barges were applied to the spreadsheets and used to derive overhead costs for remaining dimensions for similar barge types based on the methodologies described above for the different barge types.

Overhead costs have declined for most open hopper barges as well as covered hopper barges. However, given the method of applying the ratio of each open hopper barge dimension to the 195x35x12 open hopper barge, the smaller hopper barges display increased administrative costs when compared to the FY 97 Planning Guidance. These calculated costs were verified with actual data.

Based on the recent survey data, administrative costs associated with self-unloading cement barges are greater than those reported in the FY 97 Planning Guidance. There was no reported difference in the administrative costs between the two cement barge dimensions.

Administrative costs for tank barges, including oil, asphalt, pressurized, and chemical were greater than those presented in the FY 97 Planning Guidance. Administrative costs were greater by nearly 6% for oil trade tank barges and 13% for chemical barges.

**Port Costs.** Average daily port costs are shown on the barge spreadsheets as additional information for the planner. Reported port costs were much higher in this Planning Guidance than were reported in the FY 97 Planning Guidance. Port costs increased across all open hopper size classes, covered hopper, tank barges, and cement barges when compared to the FY 97 Planning Guidance. The largest increases were reported in the cement barge category. and four times greater for cement barges. Port costs were verified using actual data where available. The use of the abbreviation "NA" indicates "not applicable" and "- -" indicates "not available". "NA" is utilized for hopper barges because typically the customer pays the cost of loading and unloading, whereas "- -" is utilized for tank barge loading and unloading because the question posed to survey participants was regarding self-unloading and loading costs.

Port Costs were 11% greater for the 195x35x12 open hopper barge as compared to the FY 97 Guidance. The port costs for the remaining open hopper barge dimensions were calculated based on comparison of their capacity to the 195x35x12 open hopper barge. The premise is that port costs are a function of barge capacity. Operators of cement barges indicated significant costs for both labor and electric power in unloading cement barges. These costs are reflected in the accompanying spreadsheets. Port costs for oil tank barges increased by 40%. Port cost for chemical barges increased 8%. Again, port costs were verified using actual data where available.

**Back to top**

FY 2000 ESTIMATED DAILY OPERATING COSTS FOR MISSISSIPPI RIVER SYSTEM TOWBOATS

Horsepower Type	400- 600 Harbor or Linehaul	800- 1000 Linehaul	1200 Linehaul	1400- 1600 Linehaul	1800- 2000 Linehaul	2200- 2400 Linehaul	2800- 3400 Linehaul
Replacement Cost	\$486, 718	\$968, 220	\$1, 329, 347	\$1, 690, 474	\$2, 171, 976	\$2, 653, 479	\$3, 616, 484
Cost Recovery Basis: 20 years @ 6.625% 350 Operating Days per Year	\$127. 46	\$253. 56	\$348. 14	\$442. 71	\$568. 81	\$694. 90	\$947. 10
Operating Costs							
Crew Wages	\$624. 78	\$806. 02	\$913. 03	\$1, 005. 72	\$1, 114. 20	\$1, 210. 36	\$1, 377. 49
Fringe Benefits	\$193. 59	\$249. 75	\$282. 91	\$311. 63	\$345. 24	\$375. 04	\$426. 83
Food & Subsistence	\$35. 20	\$45. 41	\$51. 44	\$56. 66	\$62. 77	\$68. 19	\$77. 61
Transportation	\$26. 40	\$34. 06	\$38. 58	\$42. 50	\$47. 08	\$51. 14	\$58. 20
Total Crew Costs	\$879. 98	\$1, 135. 24	\$1, 285. 95	\$1, 416. 50	\$1, 569. 29	\$1, 704. 74	\$1, 940. 13
Maintain & Repair	\$203. 73	\$263. 21	\$298. 36	\$328. 83	\$364. 52	\$396. 16	\$451. 20
Supplies	\$76. 88	\$99. 32	\$112. 59	\$124. 09	\$137. 55	\$149. 50	\$170. 26
Insurance	\$73. 04	\$94. 36	\$106. 96	\$117. 88	\$130. 68	\$142. 02	\$161. 75
Other	\$30. 75	\$39. 73	\$45. 04	\$49. 64	\$55. 02	\$59. 80	\$68. 11
Total Boat Costs	\$384. 40	\$496. 62	\$562. 95	\$620. 44	\$687. 76	\$747. 48	\$851. 31
Total Operating Costs	\$1, 264. 37	\$1, 631. 85	\$1, 848. 90	\$2, 036. 95	\$2, 257. 05	\$2, 452. 22	\$2, 791. 44
Administration	\$151. 72	\$195. 82	\$221. 87	\$244. 43	\$270. 85	\$294. 27	\$334. 97
Fuel Use (Gal per Day) (Note 1)							
GPD Hi Power Use	500	900	1200	1500	1900	2300	3100
GPD Actual Use	236. 39	428. 72	573. 73	719. 21	913. 76	1108. 84	1500. 24
Fuel Cost (Note 2)							
High Power Use	\$394. 00	\$709. 20	\$945. 60	\$1, 182. 00	\$1, 497. 20	\$1, 812. 40	\$2, 442. 80
Actual Power Use	\$186. 28	\$337. 83	\$452. 10	\$566. 74	\$720. 04	\$873. 76	\$1, 182. 19
Total Daily Costs							
High Power Use	\$1, 937. 56	\$2, 790. 44	\$3, 364. 50	\$3, 906. 09	\$4, 593. 91	\$5, 253. 79	\$6, 516. 32
Actual Power Use	\$1, 729. 84	\$2, 419. 07	\$2, 871. 00	\$3, 290. 83	\$3, 816. 75	\$4, 315. 15	\$5, 255. 70
Average Crew Size	3. 00	4. 65	4. 73	4. 78	6. 29	6. 42	8. 38

Note 1 Actual daily fuel use is based on survey data and reflects variation in power use over the trip cycle for the type of towing performed by the towboat sizes shown. High power daily fuel use is based on continuous use of about 80% of full rated towboat horsepower.

Note 2 Fuel cost @ \$0.788 per gallon, based on four year average prices per gallon, Upper/Lower Miss & Ohio, \$0.545, + \$0.20 Waterway Tax + \$0.043 Deficit Reduction Tax.

FY 2000 ESTIMATED DAILY OPERATING COSTS FOR MISSISSIPPI RIVER SYSTEM TOWBOATS

Horsepower Type	4000- 4400 Li nehaul	5000- 6000 Li nehaul	6100- 7000 Li nehaul	7100- 8000 Li nehaul	8100- 9000 Li nehaul	10000 Li nehaul
Replacement Cost	\$4, 940, 615	\$6, 505, 498	\$7, 769, 442	\$8, 973, 198	\$10, 176, 955	\$11, 922, 401
Cost Recovery Basis: 20 years @ 6.625% 350 Operating Days per Year	\$1, 293. 87	\$1, 703. 69	\$2, 034. 70	\$2, 349. 94	\$2, 665. 19	\$3, 122. 29
Operating Costs						
Crew Wages	\$1, 571. 23	\$1, 765. 98	\$1, 904. 87	\$2, 025. 83	\$2, 138. 02	\$2, 288. 19
Fringe Benefits	\$486. 86	\$547. 21	\$590. 24	\$627. 72	\$662. 48	\$709. 02
Food & Subsistence	\$88. 52	\$99. 49	\$107. 32	\$114. 13	\$120. 45	\$128. 91
Transportation	\$66. 39	\$74. 62	\$80. 49	\$85. 60	\$90. 34	\$96. 68
Total Crew Costs	\$2, 212. 99	\$2, 487. 30	\$2, 682. 92	\$2, 853. 29	\$3, 011. 29	\$3, 222. 80
Maintain & Repair	\$515. 04	\$579. 26	\$625. 09	\$665. 01	\$702. 06	\$751. 66
Supplies	\$194. 35	\$218. 59	\$235. 88	\$250. 95	\$264. 93	\$283. 64
Insurance	\$184. 64	\$207. 66	\$224. 09	\$238. 40	\$251. 68	\$269. 46
Other	\$77. 74	\$87. 44	\$94. 35	\$100. 38	\$105. 97	\$113. 46
Total Boat Costs	\$971. 77	\$1, 092. 95	\$1, 179. 41	\$1, 254. 74	\$1, 324. 63	\$1, 418. 22
Total Operating Costs	\$3, 184. 76	\$3, 580. 24	\$3, 862. 33	\$4, 108. 03	\$4, 335. 93	\$4, 641. 02
Administration	\$382. 17	\$429. 63	\$463. 48	\$492. 96	\$520. 31	\$556. 92
Fuel Use (Gal per Day) (Note 1)						
GPD Hi Power Use	4200	5500	6550	7550	8550	10000
GPD Actual Use	2040. 49	2681. 30	4233. 42	5100. 48	6004. 15	7373. 44
Fuel Cost (Note 2)						
High Power Use	\$3, 309. 60	\$4, 334. 00	\$5, 161. 40	\$5, 949. 40	\$6, 737. 40	\$7, 880. 00
Actual Power Use	\$1, 607. 90	\$2, 112. 86	\$3, 335. 93	\$4, 019. 18	\$4, 731. 27	\$5, 810. 27
Total Daily Costs						
High Power Use	\$8, 170. 41	\$10, 047. 56	\$11, 521. 90	\$12, 900. 34	\$14, 258. 82	\$16, 200. 23
Actual Power Use	\$6, 468. 71	\$7, 826. 43	\$9, 696. 44	\$10, 970. 12	\$12, 252. 69	\$14, 130. 51
Average Crew Size	8. 85	9. 18	9. 54	9. 63	9. 69	10. 00

Note 1 Actual daily fuel use is based on survey data and reflects variation in power use over the trip cycle for the type of towing performed by the towboat sizes shown. High power daily fuel use is based on continuous use of about 80% of full rated towboat horsepower.

Note 2 Fuel cost @ \$0.788 per gallon, based on four year average prices per gallon, Upper/Lower Miss & Ohio, \$0.545, + \$ 0.20 Waterway Tax + \$0.043 Deficit Reduction Tax.

**FY 2000 ESTIMATED DAILY OPERATING COSTS FOR MISSISSIPPI RIVER SYSTEM BARGES**

<b>Barge Type</b> <b>Length, Width, Hull Depth</b>	<b>Open Hopper</b> <b>175' x26' x12'</b>	<b>Open Hopper</b> <b>195' x26' x12'</b>	<b>Open Hopper</b> <b>195' x35' x12'</b> (Note 1)	<b>Open Hopper</b> <b>245' x35' x12'</b>	<b>Open Hopper</b> <b>260' x52.5' x12'</b>
<b>Nominal Capacity (tons)</b> <b>Barge Service</b>	<b>925</b> <b>Coal &amp; Other</b>	<b>1100</b> <b>Coal &amp; Other</b>	<b>1500</b> <b>Coal &amp; Other</b>	<b>1900</b> <b>Coal &amp; Other</b>	<b>3100</b> <b>Coal &amp; Other</b>
<b>Replacement Cost</b>	<b>\$168,629</b>	<b>\$187,901</b>	<b>\$274,938</b>	<b>\$345,435</b>	<b>\$549,876</b>
<b>Cost Recovery Basis:</b>					
<b>20 Years @ 6.625%</b>	<b>\$42.93</b>	<b>\$47.84</b>	<b>\$70.00</b>	<b>\$87.95</b>	<b>\$140.00</b>
<b>Operating Days per Year</b>	<b>360</b>	<b>360</b>	<b>360</b>	<b>360</b>	<b>360</b>
<b>Operating Costs</b>					
<b>Maintain &amp; Repair</b>	<b>\$6.56</b>	<b>\$7.87</b>	<b>\$10.59</b>	<b>\$13.31</b>	<b>\$21.18</b>
<b>Supplies</b>	<b>\$0.87</b>	<b>\$1.05</b>	<b>\$1.41</b>	<b>\$1.77</b>	<b>\$2.82</b>
<b>Insurance</b>	<b>\$1.19</b>	<b>\$1.43</b>	<b>\$1.93</b>	<b>\$2.42</b>	<b>\$3.86</b>
<b>Other</b>	<b>\$2.30</b>	<b>\$2.76</b>	<b>\$3.72</b>	<b>\$4.67</b>	<b>\$7.44</b>
<b>Total Operating Costs</b>	<b>\$10.93</b>	<b>\$13.11</b>	<b>\$17.65</b>	<b>\$22.18</b>	<b>\$35.30</b>
<b>Administration</b>	<b>\$5.79</b>	<b>\$6.95</b>	<b>\$9.35</b>	<b>\$9.35</b>	<b>\$9.35</b>
<b>Total Daily Costs</b>	<b>\$59.65</b>	<b>\$67.90</b>	<b>\$97.00</b>	<b>\$119.48</b>	<b>\$184.65</b>
<b>Port Costs (Note 2)</b>					
<b>Shifting</b>	<b>\$13.74</b>	<b>\$16.49</b>	<b>\$22.20</b>	<b>\$27.89</b>	<b>\$44.40</b>
<b>Fleeting</b>	<b>\$4.16</b>	<b>\$4.99</b>	<b>\$6.72</b>	<b>\$8.44</b>	<b>\$13.44</b>
<b>Cleaning</b>	<b>\$2.87</b>	<b>\$3.45</b>	<b>\$4.64</b>	<b>\$5.83</b>	<b>\$9.28</b>
<b>Load/Unload</b>	<b>N. A.</b>	<b>N. A.</b>	<b>N. A.</b>	<b>N. A.</b>	<b>N. A.</b>
<b>Average Daily Port Cost</b>	<b>\$20.78</b>	<b>\$24.93</b>	<b>\$33.56</b>	<b>\$42.17</b>	<b>\$67.12</b>

**Note 1** 200' x35' box barge costs about 2.5% more, has a nominal capacity of 1600 tons

**Note 2** Trip-specific port costs vary widely, approximate average costs shown



**FY 2000 ESTIMATED DAILY OPERATING COSTS FOR MISSISSIPPI RIVER SYSTEM BARGES**

Barge Type Length, Width, Hull Depth	Covered Hopper 195' x35' x12' (Note 1)	Deck 130' x35' x10'	Deck 195' x35' x12'	Self Unloader 195' x35' x13'	Self Unloader 290' x50' x13'
Nominal Capacity (tons) Barge Service	1500 Grain & Other	750 Sand/Gravel	1500 Stone (Note 2)	1300 Cement	3000 Cement
Replacement Cost	\$314,938	\$173,987	\$309,799	\$1,294,397	\$2,750,000
Cost Recovery Basis:					
20 Years @ 6.625%	\$80.19	\$44.30	\$78.88	\$484.26	\$1,028.83
Operating Days per Year	360	360	360	245	245
Operating Costs					
Maintain & Repair	\$11.03	\$4.00	\$5.00	\$118.02	\$127.58
Supplies	\$1.58	\$0.00	\$0.00	\$1.67	\$1.80
Insurance	\$1.36	\$1.50	\$1.00	\$19.34	\$20.91
Other	\$2.28	\$2.00	\$3.00	\$21.84	\$23.60
Total Operating Costs	\$16.25	\$7.50	\$9.00	\$160.87	\$173.89
Administration	\$9.26	\$1.00	\$1.00	\$35.00	\$35.00
Total Daily Costs	\$105.70	\$52.80	\$88.88	\$680.13	\$1,237.72
Port Costs (Note 3)					
Shifting	\$27.16	N. A.	N. A.	\$20.35	\$22.00
Fleeting	\$10.28	N. A.	N. A.	\$4.16	\$4.50
Cleaning	\$7.85	N. A.	N. A.	\$0.00	\$0.00
Load/Unload	N. A.	N. A.	N. A.	\$117.67	\$250.00
Average Daily Port Cost	\$45.29	N. A.	N. A.	\$142.19	\$276.50

Note 1 200x35 box barge costs about 2.5% more, has a nominal capacity of 1600 tons

Note 2 For deck barge with coamings, add \$20,000

Note 3 Trip-specific port costs vary widely, approximate average costs shown

**FY 2000 ESTIMATED DAILY OPERATING COSTS FOR MISSISSIPPI RIVER SYSTEM BARGES**

Barge Type Length, Width, Hull Depth	Tank 195' x35' x12' Double Hull	Tank 147' x52' x12' Double Hull	Tank 175' x54' x12' Double Hull	Tank 240' x50' x12' Double Hull	Tank 290' x50' x12' Double Hull	Tank 297.5' x54' x12' Double Hull
Nominal Capacity (tons)	1425	1600	1975	2500	3000	3325
Barge Service	Oil Trades	Oil Trades	Oil Trades	Oil Trades	Oil Trades	Oil Trades
Replacement Cost (Note 1)						
Without Coils	\$689,402	\$758,220	\$906,004	\$1,107,227	\$1,297,895	\$1,414,529
With Coils	\$734,447	\$808,670	\$968,374	\$1,186,427	\$1,393,595	\$1,520,558
Cost Recovery Basis:						
20 years @ 6.625%, 350 Operating Days per Year						
Without Coils	\$180.54	\$198.57	\$237.27	\$289.97	\$339.90	\$370.44
With Coils	\$192.34	\$211.78	\$253.60	\$310.71	\$364.96	\$398.21
Operating Costs						
Maintain & Repair	\$39.17	\$43.08	\$51.48	\$62.91	\$73.74	\$80.30
Supplies	\$1.54	\$1.62	\$1.79	\$2.02	\$2.22	\$2.36
Insurance	\$17.55	\$20.70	\$27.71	\$37.72	\$47.61	\$53.86
Other	\$12.21	\$12.59	\$13.42	\$14.53	\$15.58	\$16.23
Total Operating Costs	\$70.47	\$77.99	\$94.39	\$117.18	\$139.16	\$152.75
Administration	\$21.45	\$23.49	\$27.87	\$33.85	\$39.53	\$43.02
Total Daily Costs						
Without Coils	\$272.46	\$300.04	\$359.53	\$440.99	\$518.59	\$566.22
With Coils	\$284.26	\$313.26	\$375.86	\$461.73	\$543.65	\$593.99
Port Costs (Note 2)						
Shifting	\$42.43	\$42.26	\$41.88	\$41.35	\$40.81	\$40.43
Fleeting	\$16.58	\$16.52	\$16.37	\$16.16	\$15.95	\$15.81
Cleaning	\$25.01	\$24.92	\$24.67	\$24.36	\$24.04	\$23.80
Load/Unload	--	--	--	--	--	--
Average Daily Port Cost	\$84.02	\$83.70	\$82.93	\$81.87	\$80.81	\$80.04

Note 1 Tank barge replacement costs include vapor recovery system. For multi-product piping, pumps, and fittings, add 15%.

Note 2 Trip-specific port costs vary widely, unit tow costs are minimal. Fleet average costs reflect 33% unit tows for 195' barges, 65% unit tows for all other oil barges.

**FY 2000 ESTIMATED DAILY OPERATING COSTS FOR MISSISSIPPI RIVER SYSTEM BARGES**

Barge Type	Tank	Pressure Tank	Pressure Tank	Pressure Tank
Length, Width, Hull Depth	297.5' x54' x12'	278' x50' x12'	210' x44' x12'	195' x35' x12'
	Double Hull	Type II	Type II	Type I
Nominal Capacity (tons)	3300	2500	1500	1000
Barge Service	Asphalt	Ammonia	LPG	Chlorine
Replacement Cost (Note 1)				
Without Coils	NA	\$4,350,000	\$3,168,000	\$1,980,000
With Coils	\$1,838,645	NA	NA	NA
Cost Recovery Basis:				
20 years @ 6.625%, 350 Operating Days per Year				
Without Coils	NA	\$1,139.20	\$829.65	\$518.53
With Coils	\$481.51	NA	NA	NA
Operating Costs				
Maintain & Repair	\$85.21	\$194.38	\$96.73	\$64.48
Supplies	\$134.56	\$120.56	\$2.33	\$1.56
Insurance	\$32.91	\$65.45	\$99.84	\$66.56
Other	\$35.41	\$105.26	\$43.06	\$28.71
Total Operating Costs	\$288.09	\$485.64	\$241.96	\$161.31
Administration	\$25.36	\$60.33	\$55.24	\$55.24
Total Daily Costs				
Without Coils	NA	\$1,685.17	\$1,126.86	\$735.08
With Coils	\$794.96	NA	NA	NA
Port Costs (Note 2)				
Shifting	NA	NA	NA	NA
Fleeting	NA	NA	NA	NA
Cleaning	NA	NA	NA	NA
Load/Unload	NA	NA	NA	NA
Average Daily Port Cost	NA	NA	NA	NA

Note 1 Tank barge replacement costs include vapor recovery system. For multi-product piping, pumps, and fittings, add 15%.

Note 2 Trip-specific port costs vary widely, unit tow costs are minimal. Fleet average costs reflect 33% unit tows for 195' barges, 65% unit tows for all other oil barges.

**FY 2000 ESTIMATED DAILY OPERATING COSTS FOR MISSISSIPPI RIVER SYSTEM BARGES**

Barge Type (1) Length, Width, Hull Depth	Steel Tank 195' x35' x13' Single Skin	Chemical Tank 195' x35' x12' Type III Steel	Chemical Tank 195' x35' x12' Type II Zinc Coated	Chemical Tank 195' x35' x12' Type III Lined	Chemical Tank 195' x35' x12' III Coils & Lined
Nominal Capacity (tons) Barge Service	1500 Molasses Urea Solutions Clay Slurry	1425 Benzene Toluene, Xylene Aqua Ammonia	1425 Alcohols, etc except Acids, Coatings for Cargo Purity (2)	1425 Hydrochloric Sulphuric (3) and Phosphoric (4) Acids	1425 Caustic Soda
Replacement Cost	\$651,760	\$689,402	\$734,402	\$779,402	\$824,402
Cost Recovery Basis:					
20 Years, 6.625%	\$173.16	\$180.54	\$192.33	\$204.11	\$215.90
Operating Days per Year	345	350	350	350	350
Operating Costs					
Maintain & Repair	\$22.57	\$54.17	\$52.47	\$59.24	\$62.07
Supplies	\$1.13	\$2.26	\$3.39	\$3.39	\$3.39
Insurance	\$13.54	\$23.70	\$31.60	\$28.21	\$30.47
Other	\$2.26	\$7.90	\$9.03	\$10.16	\$11.28
Total Operating Costs	\$39.50	\$88.02	\$96.48	\$101.00	\$107.20
Administration	\$14.11	\$40.62	\$40.62	\$40.62	\$40.62
Total Daily Costs	\$226.76	\$309.19	\$329.44	\$345.74	\$363.73
Port Costs (Note 5)					
Shifting	\$17.20	\$38.35	\$38.35	\$38.35	\$38.35
Fleeting	\$4.06	\$11.95	\$11.95	\$11.95	\$11.95
Cleaning	\$17.02	\$30.02	\$30.02	\$30.02	\$30.02
Load/Unload	--	--	--	--	--
Average Daily Port Cost	\$38.29	\$80.32	\$80.32	\$80.32	\$80.32

Note 1 46 CFR 153 regulations specify type construction and tank materials for hazardous cargoes. Types I, II, and III barges are all double skin. Type I construction has maximum ability to resist penetration due to collision or grounding. Table 1 in 46 CFR 153 lists tank barge cargoes and shows type barge required, and required or prohibited tank materials.

Note 2 Tank coatings are not specified in 46 CFR 153 regulations. Zinc, copper, and certain other materials are prohibited for certain cargoes. Add \$40,000 for epoxy in lieu of zinc tank coating. Multi-product barges cost about 15% more to build, 100% more to operate.

Note 3 Sulphuric acid may be carried in unlined, lead-lined, or rubber-lined steel tanks, depending on concentration. (Usually unlined)

Note 4 Phosphoric acid may be carried in rubber-lined or stainless steel tanks. (usually stainless) Other acids shown have no options.

Note 5 Trip-specific port costs vary widely, costs shown are fleet average costs. (approximate)

FY 2000 ESTIMATED DAILY OPERATING COSTS FOR MISSISSIPPI RIVER SYSTEM BARGES

Barge Type (1)	Chemical Tank	Chemical Tank
Length, Width, Hull Depth	195' x35' x12'	195' x35' x12'
	II Aluminum	II Stainless
Nominal Capacity (tons)	1425	1425
Barge Service	Acetic Acid Acrylonitrile Nitric Acid	Phosphoric Acid Maximum Cargo Purity
Replacement Cost	\$1,188,000	\$1,683,000
Cost Recovery Basis:		
20 Years, 6.625%	\$311.12	\$440.75
Operating Days per Year	350	350
Operating Costs		
Maintain & Repair	\$50.78	\$50.78
Supplies	\$3.39	\$3.39
Insurance	\$33.85	\$84.63
Other	\$11.28	\$28.21
Total Operating Costs	\$99.30	\$167.01
Administration	\$40.62	\$40.62
Total Daily Costs	\$451.05	\$648.39
Port Costs (Note 2)		
Shifting	\$38.35	\$38.35
Fleeting	\$11.95	\$11.95
Cleaning	\$30.02	\$30.02
Load/Unload	--	--
Average Daily Port Cost	\$80.32	\$80.32

Note 1 46 CFR 153 regulations specify type construction and tank materials for hazardous cargoes. Types I, II, and III barges are all double skin. Type I construction has maximum ability to resist penetration due to collision or grounding. Table 1 in 46 CFR 153 lists tank barge cargoes and shows type barge required, and required or prohibited tank materials.

Note 2 Trip-specific port costs vary widely, costs shown are fleet average costs. (approximate)